Space Weather Technical Forecast

Issued on Monday 25 November 2024 at 12:05 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Moderate Solar Activity likely, slight chance of X-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate solar activity has been observed in the last 24 hours, with a peak M9.4 flare at 25/0742 UTC from a region located beyond the NE limb.

There are currently ten active regions on the visible disc. The largest and most complex regions on the visible disc are located in the southeast quadrant (AR3905 and AR3906) and are in close proximity to each other. Both AR3905 and AR3906 contain moderately-large lead and trailing spots with continued minor development of their interior spots, with weak delta spots observed in their intermediate or trailer portions. The remaining groups on the disc are smaller and more magnetically simple. However, bright flux and associated flare activity near the northeast limb indicates a new region soon to emerge over the eastern horizon, this likely Ex-AR3879, last on the visible disc in early November.

No Earth-directed CMEs were observed. However, a filament lift-off beginning around 25/0140 UTC from the southeast quadrant has produced a CME. This is still being analysed pending updated imagery, but initial assessment is that most of the ejecta is directed south of the Sun-Earth line.

Solar Wind / Geomagnetic Activity: Solar winds as measured by ACE and DSCOVR at L1 were between Background and Slightly Elevated levels, due to minor fast-wind influence from CH94/- in the southwest disc. Wind speeds generally varied between 400-450km/s, but with a peak of 472km/s observed at 24/2156 UTC. Density was mostly Average. The Interplanetary Magnetic Field, Bt, was Weak to Moderate, peaking at 9nT at 25/2208 UTC. The north-south component of the IMF varied weakly between +7/-8nT, but with a period of more persistent negative Bz observed between 24/2000-25/0200 UTC. Phi angle was mainly negative (towards the Sun). Geomagnetic activity was mainly Quiet (Kp 0-2), but increased to become Unsettled to Active (Kp 3-4) between 24/2100-25/0300 UTC.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at Background levels. High energy electron flux (greater than 2MeV) observed by GOES16 varied between Background and Moderate levels. The associated 24-hour fluence remained well below the Active threshold. The integrated flux observed at 25/0000 UTC was 1.98e6.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with isolated M-flares likely and a slight chance of X-class flares, primarily from the largest regions in the southeast disc, or a returning region currently located close to the northeast limb.

Solar Wind / Geomagnetic Activity: There are currently no Earth-directed CMEs in the forecast. Ongoing Slightly Elevated wind speeds may briefly become Elevated on Day 1 (25 Nov) period due to an enhancement from a small coronal hole in the southwest disc. However, any significant connection appears unlikely and speeds are expected to ease to Background levels in the coming days.

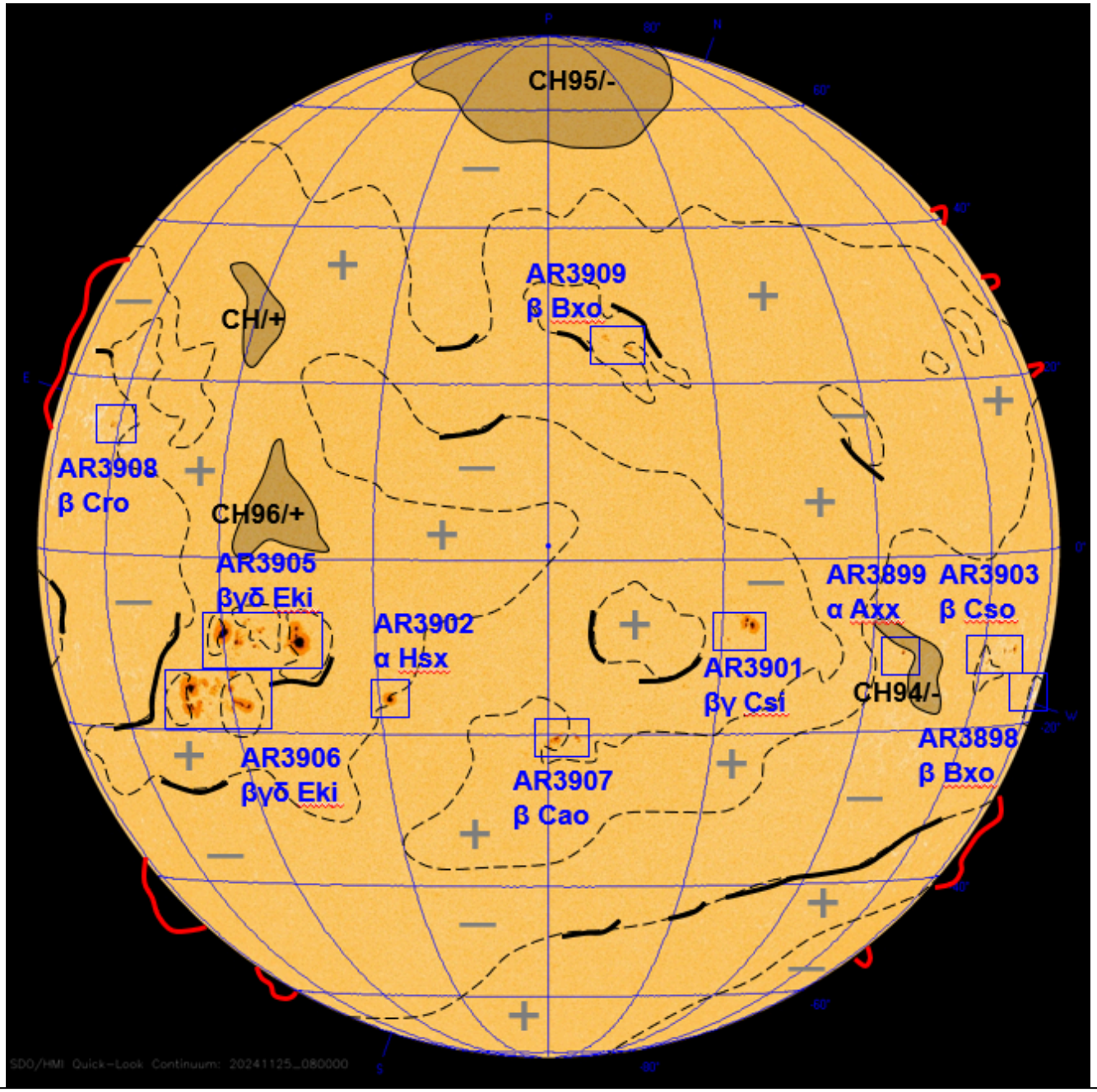
Geomagnetic activity is expected to be mainly Quiet to Unsettled through the period, but with a chance of further Active (Kp4) intervals early on Day 1 (25 Nov).

Energetic Particles / Solar Radiation: High energy protons are expected to persist at Background levels, with a slight but rising chance of enhancement during the period, mainly from the regions in the southeast. High energy electron flux has been at Background to Moderate levels and is expected to persist at these levels initially, but with diurnal increases to High flux possible, more especially later in the four-day period. Despite this associated 24 hour fluence is expected to persist below the Active threshold, but with a rising trend in the coming days.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1: Solar Synoptic Map valid 25/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms

There are no Earth-directed CMEs in the forecast. However, a filament lift-off beginning around 25/0140 UTC from the southeast quadrant has produced a CME. This is still being analysed pending updated imagery, but initial assessment is that most of the ejecta is directed south of the Sun-Earth line.

Ongoing Slightly Elevated wind speeds may become briefly Elevated on Day 1 (25 Nov) due to negative coronal hole enhancement from CH94/-, however, any significant connection appears unlikely, with speeds most likely to range between 400-450km/s. No other recurrent or forecast enhancements are forecast at present, with winds expected to ease to Background levels during the period. MOSWOC Enlil model output continues to significantly over estimate solar wind speeds, and is considered likely to be too fast through the remainder of the forecast period.

Geomagnetic activity is expected to be mainly Quiet to Unsettled through the period, but with a chance of further Active (Kp4) intervals early on Day 1 (25 Nov).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares

There are currently ten active regions on the visible disc. The largest and most complex regions on the visible disc are located in the southeast quadrant (AR3905 and AR3906) and are in close proximity to each other. Both AR3905 and AR3906 contain moderately-large lead and trailing spots with continued minor development of their interior spots, with weak delta spots observed in their intermediate or trailer portions. The remaining groups on the disc are smaller and more magnetically simple. However, bright flux and associated flare activity near the northeast limb indicates a new region soon to emerge over the eastern horizon, this likely Ex-AR3879, last on the visible disc in early November.

All current major flare risk regions remain on the visible disc through the forecast period.

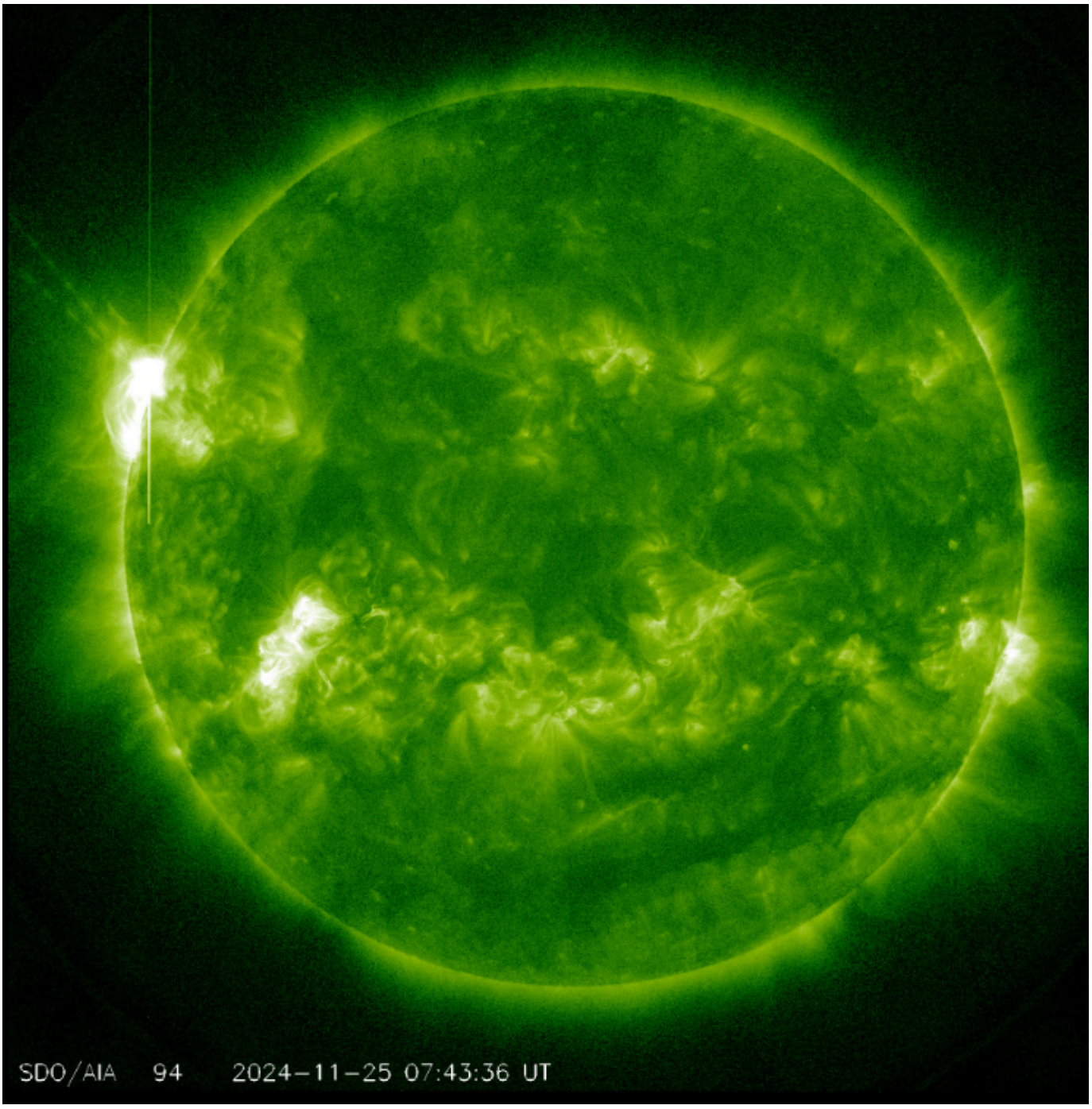
Overall solar activity is expected to be Low to Moderate, with isolated M-flares likely and a slight chance of isolated X-class flares, primarily from AR3905, AR3906 or Ex-AR3879. Probability levels have been tentatively nudged upwards through the period in anticipation of a potentially active oncoming region in the northeast.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	65	70	70	70
Very Active	R3-R5 (X Class)	No	10	15	15	15

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

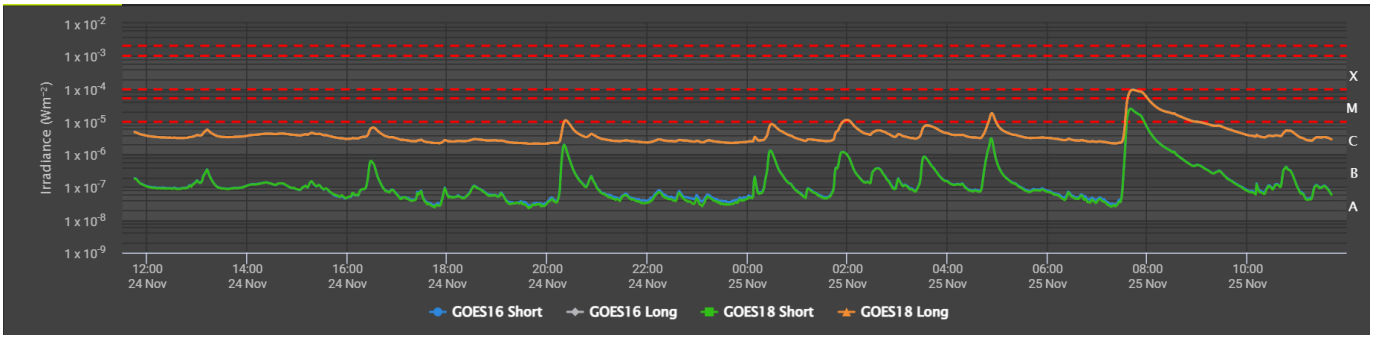
Figure 2: SDO/AIA 94 imagery at 25/0743 UTC. Notable bright flux evident from Ex-AR3879 near the northeast limb, associated with the M9 flare. AR3905 and AR3906 in the southeast also showing some brighter flux, indicating active regions.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 3: Latest GOES16/18 X Ray flux



© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

GOES-18 Proton flux is at Background levels. The main regions currently on the visible disc which are most likely to produce proton enhancements are AR3905 and AR3906, located in the southeast quadrant. From this position on the disc any proton enhancements are less likely to affect Earth, but as they rotate towards centre disc in the coming days the risk increases marginally. The observed proton flux is subsequently expected to persist at Background levels with a slight but rising chance of further enhancement into the period as AR3905 and AR3906 reach a more favourable position to become geo-effective should any proton-rich flares occur.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

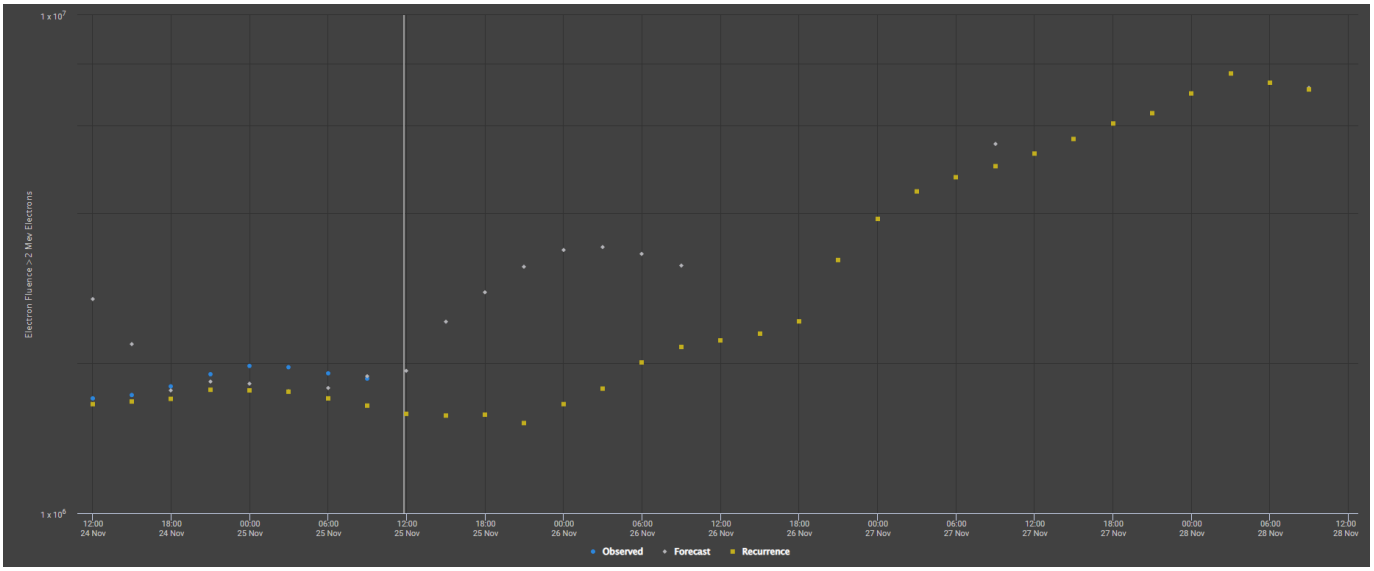
High Energy Electrons (≥ 2MeV)

Electron flux observed by GOES-16 has been at Background to Moderate levels and is expected to persist at these levels initially, but with diurnal increases to High flux possible, more especially later in the four-day period following the easing of the HSS from CH94/-.

Associated 24 hour fluence is expected to persist below the Active threshold, but with a rising trend in the coming days and MOSWOC REFM output thought to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM forecast with Recurrence



© Crown Copyright 2024. All Rights Reserved.